



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Ivan V. MENDENHALL  
Robert D. TAYLOR

Serial No.: 10/704,499

Filing Date: 07 November 2003

Title: BURN RATE ENHANCEMENT VIA  
METAL AMINOTETRAZOLE  
HYDROXIDES

Customer No.: 45483

Group No.: 1755

Examiner:  
Aileen Baker Felton

**DECLARATION OF DR. IVAN V. MENDENHALL**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

Declarant, Dr. Ivan V. Mendenhall, declares as follows:

1. I am one of the joint inventors of the subject matter described and claimed in the above-identified patent application.

I hereby certify that this correspondence (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on

20 June 2007

20 June 2007

Date



Signature

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2. I have a Doctorate degree in Food Chemistry and a Bachelor of Science degree in Chemistry, each from Utah State University.

3. I have more than fifteen years of work experience studying copper complex chemistry and the use of these compounds in gas generating formulations in the field of energetic materials including more than four years experience as an Analytical Chemist and more than eleven years experience as a Formulation Chemist.

4. I am presently the Senior Specialist of Formulation Chemistry for Autoliv ASP, Inc., a corporation duly organized and existing under and by virtue of the laws of the State of Indiana and having a principal office and place of business at 3350 Airport Road, Ogden, Utah 84405.

5. I have read and reviewed the Final Office Action dated as mailed 21 February 2007 ("Final Action") and the outstanding prior art rejections of the pending claims appearing therein.

6. I have read and reviewed:

- a. cited and applied U.S. Patent 6,143,102 to Mendenhall et al., including its specification and claims;  
and
- b. cited and applied U.S. Patent 6,517,647 to Yamato, including its specification and claims.

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7. I am one of the joint inventors of the subject matter described and claimed in U.S. Patent 6,143,102 to Mendenhall et al. and am closely familiar with the disclosure therein contained.

8. The compositions of U.S. Patent 6,143,102 to Mendenhall et al., such as identified in the Final Action in Section 5 on page 3, and such as including tetrazole complexes of copper or zinc and basic copper nitrate, did not include tetrazole hydroxide salts, rather the compositions of U.S. Patent 6,143,102 to Mendenhall et al. included tetrazole complexes in the nature of copper bis aminotetrazole, i.e.,  $\text{Cu}(\text{CH}_2\text{N}_5)_2$ .

9. I am one of the joint inventors of the subject matter described and claimed in U.S. Patent 6,958,101 to Mendenhall et al., entitled, "SUBSTITUTED BASIC METAL NITRATES IN GAS GENERATION."

10. The compositions of U.S. Patent 6,517,647 to Yamato, such as identified in the Final Action in Section 4 on page 3, and such as including 5-aminotetrazole and basic copper or zinc nitrate do not include tetrazole hydroxide salts, rather the reaction of 5-aminotetrazole with basic copper nitrate has been shown in above-identified U.S. Patent 6,958,101 to Mendenhall et al. to be  $2\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{CH}_2\text{N}_5)_2 \cdot \text{Cu}(\text{NO}_3)_2$ , also known as copper, hydroxynitrate 1 H-tetrazol - 5 - amine complex.

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11. I have conducted and/or assisted on additional series of tests and analysis, including X-ray diffraction pattern testing, to further determine, evaluate and compare metal aminotetrazole hydroxides, particularly copper aminotetrazole hydroxides, in accordance with the invention with:

- a. compositions including tetrazole complexes of copper or zinc and basic copper nitrate, such as identified in the Final Action in Section 5 on page 3 with reference to U.S. Patent 6,143,102 to Mendenhall et al.; and
- b. compositions including 5-aminotetrazole and basic copper or zinc nitrate, such as identified in the Final Action in Section 4 on page 3 with reference to U.S. Patent 6,517,647 to Yamato.

12. The X-ray diffraction patterns obtained for copper aminotetrazole hydroxide (invention), copper bis aminotetrazole (U.S. Patent 6,143,102 to Mendenhall et al.) and copper, hydroxynitrate 1 H-tetrazol - 5 - amine complex (U.S. Patent 6,517,647 to Yamato) are attached and shown as FIGS. 1-3, respectively.

13. FIGS. 1-3 show that copper aminotetrazole hydroxide (invention), copper bis aminotetrazole (U.S. Patent 6,143,102 to Mendenhall et al.) and copper, hydroxynitrate 1 H-tetrazol - 5 - amine complex (U.S. Patent 6,517,647 to Yamato) each have a unique X-ray diffraction pattern.

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14. TABLE I, below, identifies chemical and physical values obtained and properties realized for copper aminotetrazole hydroxide ( $\text{Cu}(\text{CH}_2\text{N}_3)(\text{OH})$ , invention), copper bis aminotetrazole ( $\text{Cu}(\text{CH}_2\text{N}_3)_2$ , U.S. Patent 6,143,102 to Mendenhall et al.) and copper, hydroxynitrate 1 H-tetrazol - 5 - amine complex ( $2\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{CH}_2\text{N}_3)_2 \cdot \text{Cu}(\text{NO}_3)_2$ , U.S. Patent 6,517,647 to Yamato).

**TABLE I**

<b>Characteristic</b>	<b>Invention</b>	<b>US 6143102</b>	<b>US 6517647</b>
	$\text{Cu}(\text{CH}_2\text{N}_3)(\text{OH})$	$\text{Cu}(\text{CH}_2\text{N}_3)_2$	$2\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{CH}_2\text{N}_3)_2 \cdot \text{Cu}(\text{NO}_3)_2$
<b>Color</b>	Purple	Green	Blue
<b>Autoignition Temp °C</b>	150	130	164
<b><math>\Delta\text{H}</math> formation cal/g</b>	-147	212	-338
<b>% Cu</b>	35.43	28.30	41.43
<b>% C</b>	7.99	8.75	4.61
<b>% H</b>	2.18	3.12	1.70
<b>% N</b>	40.43	55.17	28.07
<b>% O (by difference)</b>	13.97	4.66	24.19

15. The chemical and physical values and properties presented in TABLE I clearly demonstrate that copper aminotetrazole hydroxide (invention), copper bis aminotetrazole (U.S. Patent 6,143,102 to Mendenhall et al.) and copper, hydroxynitrate 1 H-tetrazol - 5 - amine complex (U.S. Patent 6,517,647 to Yamato) each have unique identity.

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### CONCLUSION

16. The provision of a method for increasing the burn rate of a gas generant formulation through the addition of a quantity of at least one metal aminotetrazole hydroxide to the gas generant formulation is novel and unobvious over U.S. Patent 6,143,102 to Mendenhall et al. and U.S. Patent 6,517,647 to Yamato at the time the invention was made.

17. All statements made herein of my knowledge are true; all statements made on information and belief are believed to be true; and I make these statements with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Ivan V. Mendenhall  
Dr. Ivan V. Mendenhall

June 18, 2007  
Date

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